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Real-Time Facial Emotion Recognition Using Machine Learning

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ABSTRACT

Face detection has been around for ages. Taking a step forward, human emotion displayed by face and felt by the brain, captured in either video, electric signal (EEG) or image form can be approximated. Human emotion detection is the need of the hour so that modern artificial intelligent systems can emulate and gauge reactions from the face. This can be helpful to make informed decisions, be it regarding identification of intent, promotion of offers or security related threats. Recognizing emotions from images or video is a trivial task for the human eye, but proves to be very challenging for machines and requires many image processing techniques for feature extraction. Several machine learning algorithms are suitable for this job. Any detection or recognition by machine learning requires training algorithms and then testing them on a suitable dataset. This paper explores a couple of machine learning algorithms as well as feature extraction techniques which would help us in accurate identification of the human emotion. Facial recognition is a technology that is capable of recognizing a person based on their face. It employs machine learning algorithms which find, capture, store and analyze facial features in order to match them with images of individuals in a pre-existing database.

INDEX TERMS: Facial recognition, expression recognition, machine learning, image recognition, Facial technology, emotion recognition, image classification.

I. INTRODUCTION

Human emotion detection is implemented in many areas requiring additional security or information about the person. It can be seen as a second step to face detection where we may be required to set up a second layer of security, where along with the face, the emotion is also detected. This can be useful to verify that the person standing in front of the camera is not just a 2-dimensional representation. Another important domain where we see the importance of emotion detection is for business promotions[1]. Most of the businesses thrive on customer responses to all their products and offers. If an artificial intelligent system can capture and identify real time emotions based on user image or video, they can make a decision on whether the customer liked or disliked the product or offer. We have seen that security is the main reason for identifying any person. Human emotions can be classified as: fear, contempt, disgust, anger, surprise, sad, happy, and neutral. These emotions are very subtle. Facial muscle contortions are very minimal and detecting these differences can be very challenging as even a small difference results in different expressions. Also, expressions of different or even the same people might vary for the same emotion, as emotions are hugely context dependent While we can focus on only those areas of the face which display a maximum of emotions like around the mouth and eyes , how we 2 extract these gestures and categorize them is still an important question. Neural networks and machine learning have been used for these tasks and have obtained good results. Machine learning algorithms have proven to be very useful in pattern recognition and classification. The most important aspects for any machine learning algorithm are the features. In this paper we will see how the features are extracted and modified for algorithms like Support Vector Machines[4]. The human emotion dataset can be a very good example to study the robustness and nature of classification algorithms and how they perform for different types of dataset. It can employ various types of techniques to identify the emotion like calculating the ellipses formed on the face or the angles between different parts like eyes, mouth etc.

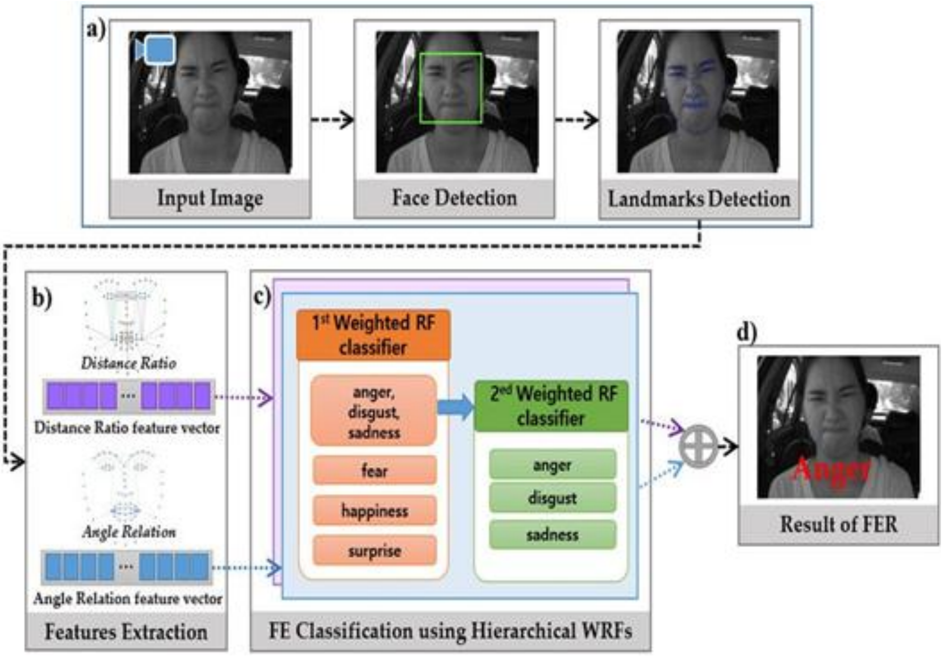
II. EXISTING SYSTEM

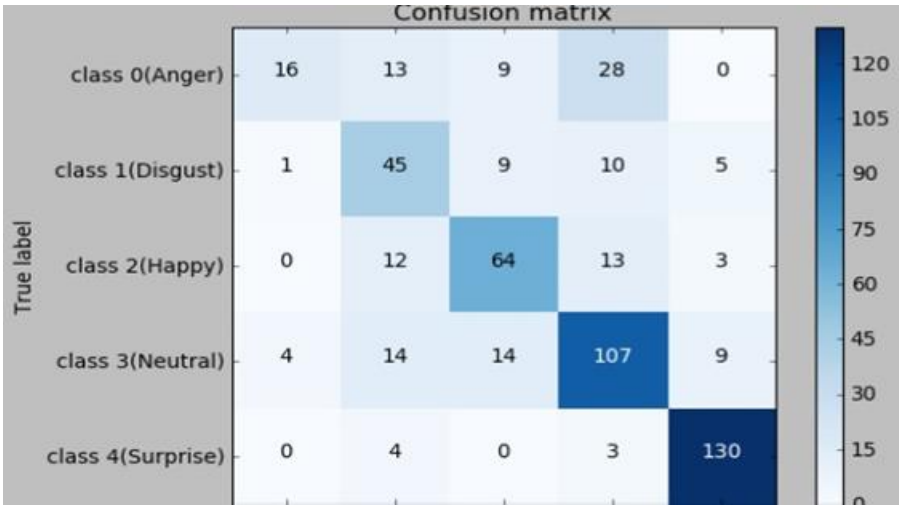
Now present the performance of the proposed model on the above datasets. In each case, we train the model on a subset of that dataset and validate on validation set, and report the accuracy over the test set. Before getting into the details of the model's performance on different datasets, we briefly discuss our training procedure. We trained one model per dataset in our experiments, but we tried to keep the architecture and hyper-parameters similar among these different models[6]. Each model is trained for 500 epochs from scratch, on an AWS EC2 instance with a Nvidia Tesla K80 GPU. We initialize the network weights with random Gaussian variables with zero mean and 0.05 standard deviation[7]. For optimization, we used Adam optimizer with a learning rate of 0.005 with weight decay (Different optimizer were tried, including stochastic gradient descents, and Adam seemed to be performing slightly better). It takes around 2-4 hours to train our models on FER and FERG datasets. For JAFFE and CK+, since there are much fewer images, it takes less than 10 minutes to train a model. Data augmentation is used for the images in the training sets to train the model on a larger number of images, and make the trained model for invariant on small transformations[9].

III. PROPOSED SYSTEM

The self-organizing map also known as a Kohonen Map is a well-known artificial neural network. It is an unsupervised learning process, which learns the distribution of a set of patterns without any class information. It has the property of topology preservation. There is a competition among the neurons to be activated or fired. The result is that only one neuron that wins the competition is fired and is called the"winner.A SOM network identifies a winning neuron using the same procedure as employed by a competitive layer. However, instead of updating only the winning neuron, all neurons within a certain neighborhood of the winning neuron are updated using the Kohonen Rule. The Kohonen rule allows the weights of a neuron to learn an input vector, and because of this it is useful in recognition applications[10]. Hence, in this system, a SOM is employed to classify DCT-based vectors into groups to identify if the subject in the input image is "present" or "not present" in the image database.After the face has been located in the image or video frame, it can be analyzed in terms of facial action occurrence.

There are two types of features that are usually used to describe facial expression: geometric features and appearance features. Geometric features measure the displacements of certain parts of the face such as brows or mouth corners, while appearance features describe the change in face texture when particular action is performed. Apart from feature type, FER systems can be divided by the input which could be static images or image sequences[8]. The task of geometric feature measurement is usually connected with face region analysis, especially finding and tracking crucial points in the face region. Possible problems that arise in face decomposition task could be occlusions and occurrences of facial hair or glasses[2]. Furthermore, defining the feature set is difficult, because features should be descriptive and possibly not correlated.





Random Forest Classifiers have also proven to have an upper hand over SVM in some of the cases [9]. Random forests are based on decision trees, but instead of just one classifier, use more forests or classifiers to decide the class of the target variable. The result of random forest classifier for detecting 6,7 and 8 emotions. Here, S1 to S5 represent the subset of emotion used for detection. K-Nearest Neighbor, Linear Discriminant Analysis and Neural Networks (ANN) are some of the algorithms used for classification of prediction of emotion.It tries to improve on the existing HMM by incorporating some characteristics of multiple classifiers. Also, HMM are used in sequence with algorithms such as k-Nearest Neighbor. Advantage of using both the methods is HMM can do the complex computations and k-NN just have to classify between the given samples. HMM decision is based on biggest output probability which might be mixed with noise, whereas K-NN can add a second layer of classification thereby increasing accuracy.

IV. CONCLUSION

This project proposes an approach for recognizing the category of facial expressions.Face Detection and Extraction of expressions from facial images is useful in many applications, such as robotics vision, video surveillance, digital cameras, security and human-computer interaction. This project's objective was to develop a facial expression recognition system implementing the computer visions and enhancing the advanced feature extraction and classification in face expression recognition.There is increasing integration of computers and computer interfaces in our lives, due to the arise in the need of computers in order to be able to recognize and respond to human communication and behavioral cues of emotions and mental states. The automated analysis of expressions is a challenging endeavor because of the uncertainty inherent in the inference of hidden mental states from behavioral cues. As the facial expression recognition systems are becoming robust and effective in communications, many other innovative applications and uses are yet to be seen. The objective of this research paper is to give brief overview towards the process, various techniques, and application of facial emotion recognition system.

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